

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

- 1 1. (Original) A magnetic field sensor for sensing an applied magnetic field, the
2 sensor comprising:
3 a layer of magnetostrictive material having a magnetization vector that
4 responds to the applied magnetic field by rotating in a plane and generating a
5 stress;
6 a layer of electroactive material, mechanically bonded to the layer of
7 magnetostrictive material, that responds to the stress by generating a voltage; and
8 electrodes that measure the voltage generated by the electroactive
9 material in a direction substantially parallel to the plane in which the magnetization
10 vector rotates.
- 1 2. (Original) The sensor of claim 1 wherein the magnetostrictive material is selected
2 from the group consisting of amorphous-FeBSi, FeCoBSi alloys, polycrystalline
3 nickel, iron-nickel alloys, iron-cobalt alloys and Terfenol-D®.
- 1 3. (Original) The sensor of claim 2 wherein the magnetostrictive material is selected
2 from the group consisting of $\text{Fe}_x\text{B}_y\text{Si}_{1-x-y}$, where $70 < x < 86$ at%, $2 < y < 20$, and
3 $0 < z = 1 - x - y < 8$ at%, $\text{Fe}_x\text{Co}_y\text{B}_z\text{Si}_{1-x-y-z}$ where $70 < x + y < 86$ at% and y is between
4 1 and 46 at%, $2 < z < 18$, and $0 < 1 - x - y - z < 16$ at%, polycrystalline nickel, iron-
5 nickel alloys where Ni is between 40 and 70 at%, iron-cobalt alloys where Co
6 between 30 and 80%, and Terfenol-D® $\text{Fe}_2(\text{Dy}_{0.67}\text{Tb}_{0.33})$.
- 1 4. (Original) The sensor of claim 2 wherein the magnetostrictive material comprises
2 a composition near $\text{Fe}_{78}\text{B}_{20}\text{Si}_2$.

- 1 5. (Original) The sensor of claim 2 wherein the magnetostrictive material comprises
2 a composition near $\text{Fe}_{68}\text{Co}_{10}\text{B}_{18}\text{Si}_4$.
- 1 6. (Original) The sensor of claim 2 wherein the magnetostrictive material comprises
2 an iron-nickel alloy with substantially 50% Ni.
- 1 7. (Original) The sensor of claim 2 wherein the magnetostrictive material comprises
2 an iron-cobalt alloy with substantially 55% Co.
- 1 8. (Original) The sensor of claim 1 wherein the electroactive material is selected
2 from the group consisting of lead zirconate titanate ceramics ($\text{Pb}(\text{Zr}_x\text{Ti}_{1-x})\text{O}_3$),
3 polyvinylidene difluoride polarized polymers (PVDF), aluminum nitride (AlN),
4 quartz (SiO_x), ferroelectric materials, electrostrictive materials and relaxor
5 ferroelectric materials.
- 1 9. (Original) The sensor of claim 8 wherein the electroactive material is
2 electrostrictive material substantial of the form $(\text{Bi}_{0.5}\text{Na}_{0.5})_{1-x}\text{Ba}_x\text{Zr}_y\text{Ti}_{1-y}\text{O}_3$.
- 1 10. (Original) The sensor of claim 8 wherein the electroactive material is a relaxor
2 ferroelectric material substantially of the form $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})_3\text{O}_3$.
- 1 11. (Original) The sensor of claim 1 wherein the magnetostrictive layer is bonded to
2 the electroactive layer with non-conductive glue.
- 1 12. (Original) The sensor of claim 11 wherein the glue is non-conductive epoxy.
- 1 13. (Original) The sensor of claim 1 wherein the electroactive layer is a rectangular
2 prism having thickness, t , width, w , and length, l , with $t \leq w \leq l$ and three pairs of
3 opposing faces and wherein the electrodes are on one pair of opposing faces

4 and the magnetostrictive layer and a second magnetostrictive layer are bonded
5 to another pair of opposing faces.

1 14. (Original) The sensor of claim 13 wherein a third and a fourth magnetostrictive
2 layers are bonded to the third pair of opposing faces.

1 15. (Original) The sensor of claim 14 wherein the magnetostrictive layer is a
2 continuous piece wrapped around and bonded to two pairs of opposing sides and
3 the electrodes are on a third pair of opposing sides.

1 16. (Original) The sensor of claim 1 wherein the magnetostrictive layer is disk-
2 shaped

1 17. (Original) The sensor of claim 1, wherein the electroactive layer is a cylinder with
2 two circular faces and a side wall, the magnetostrictive layer is bonded to at least
3 one circular face and electrodes are on the side wall in an opposing relationship.

1 18. (Original) The sensor of claim 17 wherein the side wall has a circumference and
2 wherein the electrodes are arc-shaped, each electrode having an arc length of at
3 least $1/8$ and not greater than $3/8$ of the circumference of the side wall.

1 19. (Original) The sensor of claim 1 wherein the electroactive layer is a cylinder of
2 thickness, t , and diameter, d , and wherein $t \geq d$.

1 20. (Original) The sensor of claim 1 wherein the electroactive layer is a cylinder with
2 two circular faces of diameter d and a side wall of height h wherein $h \geq d$ and
3 wherein the electrodes are on the circular faces and the magnetostrictive layer is
4 bonded to the side wall.

1 21. (Original) The sensor of claim 1, wherein the electroactive layer forms a hollow
2 cylinder of length l , thickness t , and diameter, d where $t < d/2$ and $t \leq l$ and a pair
3 of opposing end faces.

1 22. (Original) The sensor of claim 21 wherein the electrodes are applied to an inner
2 cylinder surface and an outer cylinder surface.

1 23. (Original) The sensor of claim 22 wherein the magnetostrictive layer comprises a
2 cylinder of magnetostrictive material inserted into the hollow cylinder of
3 electroactive material.

1 24. (Original) The sensor of claim 21 wherein the electrodes are applied to the
2 opposing end faces.

1 25. (Original) The sensor of claim 21 wherein the magnetostrictive material layer
2 comprises a single piece of magnetostrictive material wrapped over, and bonded
3 to, an outer surface of the cylinder.

1 26. (Original) The sensor of claim 21 wherein the magnetostrictive material layer
2 comprises a single piece of magnetostrictive material wrapped over, and bonded
3 to, an inner surface of the cylinder.

1 27. (Original) A magnetic field sensor for sensing an external magnetic field, the
2 sensor comprising:
3 a layer of magnetostrictive material having a magnetization vector that
4 responds to the applied magnetic field by rotating in a plane and generating a
5 stress;
6 a layer of electroactive material mechanically bonded to the layer of
7 magnetostrictive material that responds to the stress by generating a voltage; and

means for measuring the voltage generated by the electroactive material in a direction substantially parallel to the plane in which the magnetization vector rotates.

28. (Original) The sensor of claim 27 wherein the electroactive layer is a rectangular prism having thickness, t , width, w , and length, l , with $t \leq w \leq l$ and three pairs of opposing faces and wherein the electrodes are on one pair of opposing faces and the magnetostrictive layer and a second magnetostrictive layer are bonded to another pair of opposing faces.

29. (Original) The sensor of claim 27 wherein the magnetostrictive layer forms a hollow cylinder with an axis and a surface and the magnetostrictive layer has a magnetization vector that changes orientation from circumferential to axial on the surface of the cylinder in response to an external magnetic field applied in a direction parallel to the axis.

30. (Original) The sensor of claim 27 wherein the electroactive layer forms a hollow cylinder with an axis and a surface and wherein the magnetostrictive layer is wrapped around and bonded to the surface and has a magnetization vector that changes orientation from circumferential to axial on the surface of the cylinder in response to an external magnetic field applied in a direction parallel to the axis.

31. (Original) The sensor of claim 30 further comprising a second magnetostrictive layer bonded to an inner surface of the hollow cylinder, wherein the second magnetostrictive layer has a magnetization vector that changes orientation from circumferential to axial on the surface of the cylinder in response to an external magnetic field applied in a direction parallel to the axis.

32.-42. (Cancelled).

1 43. (New) An apparatus that responds to an external magnetic field, the apparatus
2 comprising:

3 a layer of magnetostrictive material having a magnetization vector that
4 responds to the magnetic field by rotating in response to the magnetic field and
5 generating a magnetostrictive stress in a direction;

6 a layer of electroactive material, mechanically bonded to the layer of
7 magnetostrictive material, that responds to the magnetostrictive stress by
8 generating a voltage; and

9 electrodes across which appears the voltage generated by the
10 electroactive material in a direction substantially parallel to the direction in which
11 the principal magnetostrictive stress is generated.

1 44. (New) The apparatus of claim 43 wherein the magnetostrictive material is
2 selected from the group consisting of amorphous-FeBSi, FeCoBSi alloys,
3 polycrystalline nickel, iron-nickel alloys, iron-cobalt alloys and Terfenol-D®.

1 45. (New) The apparatus of claim 43 wherein the electroactive layer is a rectangular
2 prism having three pairs of opposing faces and wherein the electrodes are on
3 one pair of opposing faces and the magnetostrictive layer is bonded to one face
4 of another pair of opposing faces.

1 46. (New) The apparatus of claim 45 further comprising a second magnetostrictive
2 layer bonded to another face of the other pair of opposing faces.

1 47. (New) The apparatus of claim 45 wherein the magnetostrictive layer is a
2 continuous piece wrapped around and bonded to two pairs of opposing sides and
3 the electrodes are on a third pair of opposing sides.

1 48. (New) The apparatus of claim 43 wherein the magnetostrictive layer is disk-
2 shaped

1 49. (New) The apparatus of claim 43, wherein the electroactive layer is a cylinder
2 with two circular faces and a side wall, the magnetostrictive layer is bonded to at
3 least one circular face and electrodes are on the side wall in an opposing
4 relationship.